METHOD FOR PRODUCING A FIBROUS WEB, AND MONITORING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a U.S. National Stage of International Patent Application No. PCT/EP2003/050706 filed October 9, 2003, and claims priority of German Patent Application No. 102 47 555.5 filed October 11, 2002.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates to a method for producing a fibrous web, in particular a paper or board web, from at least one fibrous suspension having a fibrous suspension density, having at least one circulating wire to which, by means of at least one headbox, the fibrous suspension is applied with a fibrous suspension height and which is led over a series of dewatering elements.

[0003] The invention also relates to a monitoring system for at least one fibrous suspension used during the production of a fibrous web, in particular a paper or board web, and having both a fibrous suspension density (FSD) and a fibrous suspension height (FSH), which is brought by at least one headbox to at least one circulating wire, which is led over a series of dewatering elements.

2. Discussion of Background Information

[0004] The aforementioned properties of the fibrous suspension, in particular the fibrous suspension density and the fibrous suspension height, are currently determined with the aid of transportable measuring instruments, such as the Gamma Gage and the Ultra Sonus, at an extremely wide range of points in a paper or board machine. This extremely wide range of points is in this case preferably located at the wet end of a paper or board machine, this wet end generally comprising the stock approach, the headbox and the wire section, for example in the form of a gap or hybrid former.

[0005] At measuring points of interest which cannot be reached via transportable measuring instruments of this type, the theoretical fibrous suspension height is calculated, provided the throughput quantities can be determined. The same procedure is normally used when determining the theoretical fibrous suspension density. Measuring points of this type which are of

interest are, for example, the forming units of gap or hybrid formers, accurate measurements in these regions being difficult because of their inaccessibility or possible only with considerable effort.

SUMMARY OF THE INVENTION

[0006] Therefore, the instant invention provides an improved method and an improved monitoring system of the type mentioned at the beginning with which economic and reliable determination and monitoring both of the fibrous suspension height and of the fibrous suspension density are ensured at all measuring points of interest, which may also be complicated or difficult to access.

[0007] In a method of the type mentioned at the beginning, according to the invention the fibrous suspension height and/or the fibrous suspension density is measured by means of at least one measuring cell which is fitted in a stationary manner and is not in direct contact with the fibrous suspension, in that the measured value obtained is evaluated in an associated process control system of the appropriate paper or board machine and is preferably compared with two predefinable limiting values (upper limiting value, lower limiting value), and in that, depending on the result of the evaluation or if at least one of the predefinable limiting values is violated, at least one actuating element is appropriately automatically activated or influenced via the process control system, in order to signal the violation of the limiting value and/or to initiate at least one appropriate countermeasure, with which a further increase or reduction in the fibrous suspension height and/or the fibrous suspension density of the region monitored is counteracted.

[0008] On the basis of this configuration, not only is the determination both of the fibrous suspension height and of the fibrous suspension density ensured at all measuring points of interest, which may possibly also be complicated or difficult to access, it is also ensured that, for example in the case in which a critical value is reached, countermeasures are initiated automatically by means of the process control system in order to prevent further developments and therefore possible production disadvantages.

[0009] Furthermore, in further refinement, the measured value determined can also be used as a controlled variable for the already known control of the pre-dewatering section by means of the measured throughput quantities in the hybrid part (previous controlled variable) by means of the fibrous suspension height determined and/or fibrous suspension density determined, as a new controlled variable.

[0010] Furthermore, the invention provides for the fibrous suspension height and/or the fibrous suspension density to be measured by at least one measuring cell fitted in a stationary manner close to the surface in the headbox and/or in the dewatering element and/or in the framing of the paper or board machine. By means of this stationary fitting of the measuring cell, continuous and reliable process measurement with constant measuring conditions and high runnability is ensured.

[0011] It is also advantageous if the fibrous suspension height and/or the fibrous suspension density - viewed at right angles to the machine running direction - is measured at a plurality of points at a respective distance from one another by means of a plurality of measuring cells fitted in a stationary manner. In this case, the distance between the measuring points can assume a value in the range from 50 mm to 1000 mm, preferably from 100 mm to 500 mm. By means of this kind of fitting, in addition to a longitudinal direction profile in the machine running direction, a tranverse profile at right angles to the machine running direction can be set up in a particular way with substantially higher meaningfulness.

[0012] According to a preferred refinement of the method according to the invention, the measurement is part of a control system which, moreover, comprises signal conversion following the measurement and data processing to be carried out by means of the process control system. By means of the measurement, for example, the structure of the fibrous web to be formed can be determined in the z direction and, if appropriate, can be regulated or controlled by means of adapting the dewatering performance (vacuum, foil angle and the like) in the machine direction upstream of the measuring point.

[0013] If a relevant limiting value is violated, at least one of the following countermeasures is advantageously initiated:

[0014] a) a reduction or increase in the wire speed of the paper or board machine;

[0015] b) a reduction or increase in the dewatering performance in the machine running direction upstream of the measuring cell;

[0016] c) a reduction or increase in the fibrous suspension density of the fibrous suspension supplied; by means of

[0017] d) a reduction or increase in the quantity of fibrous suspension applied to the circulating wire.

[0018] In this case, at least one of the following steps can be initiated:

[0019] In order to change the wire speed, for example, at least one drive of the paper or board machine can be influenced appropriately; in order to change the dewatering performance, for example, the suction performance of an upstream dewatering element can be influenced appropriately; in order to change the fibrous suspension density, at least the quantity of dilution water supplied to the fibrous suspension, the levels of vacuum on individual or a plurality of dewatering elements and/or forming roll vacuum, the metering of chemicals, such as retention aid and the like, and/or the wire tension on the former, for example on the gap former, can be influenced appropriately and, in order to change the quantity of fibrous suspension applied to the circulating wire, at least one headbox pump of the headbox can be influenced appropriately. The actuating elements mentioned previously can therefore be, for example, drives of the paper or board machine, valves, pumps, signal generators and/or the like.

[0020] If a relevant limiting value is violated, for example an alarm signal can be generated.

[0021] According to an expedient refinement of the method according to the invention, if a first limiting value is violated, first of all a warning signal is generated and, if a further limiting value is violated, at least an appropriate countermeasure is initiated.

[0022] In preferred embodiments, the headbox comprises at least one headbox slice, a dividing element, a slat and/or the like, and the dewatering element comprises at least one forming roll, a forming foil, a skimmer strip, a supporting strip, a sealing strip, a dewatering box, a foil box and/or the like.

[0023] The monitoring system according to the invention accordingly comprises at least one measuring cell which is fitted in a stationary manner and is not in direct contact with the fibrous suspension for measuring the fibrous suspension height and/or the fibrous suspension density, which is connected to a process control system associated with the paper or board machine, the measured value determined by the measuring cell being evaluated in the process control system and preferably compared with the at least two predefinable limiting values (upper limiting value, lower limiting value) and, depending on the result of the evaluation or if at least one of the predefinable limiting values is violated, it being possible for at least one actuating element to be automatically activated or influenced appropriately, in order to signal the violation of the limiting value and/or to initiate at least one appropriate countermeasure, with which a further increase or reduction in the fibrous suspension height and/or the fibrous suspension density of the region monitored is counteracted.

[0024] The measuring cell fitted in a stationary manner and close to the surface for measuring the fibrous suspension height and/or the fibrous suspension density is advantageously provided in the headbox and/or in the dewatering element and/or in the framing of the paper or board machine. In this case, the headbox comprises at least one headbox slice, a separating element, a slat and/or the like, whereas the dewatering element comprises at least one forming roll, a forming foil, a skimmer strip, a supporting strip, a sealing strip, a dewatering box, a foil box and/or the like.

[0025] The measuring cell fitted in a stationary manner can be embedded in a component surrounding it or it can be introduced into a hollow space preferably specifically produced. By means of this kind of fitting of the measuring cell, continuous and reliable process measurement with constant measuring

conditions and high runnability is ensured, moreover additional wear and additional contamination being avoided.

[0026] In addition, the measuring cell fitted in a stationary manner can be enclosed, at least with respect to the side of the wire, or it can form part of the surface of the dewatering element. In the case of both refinements, the advantage is achieved that point by point disturbances to the measurement are avoided by means of a constant contact pressure over the machine width.

[0027] By means of this arrangement of the measuring cell, furthermore, the advantage is achieved that it can be incorporated without great difficulties in already existing dewatering elements and/or in the framing. As a result, it is in particular suitable to be retrofitted to existing plants.

[0028] It is also advantageous if a plurality of measuring cells fitted in a stationary manner for measuring the fibrous suspension height and/or the fibrous suspension density - viewed at right angles to the machine running direction - are provided at a plurality of points at a respective distance from one another. In this case, the distance between the measuring points can assume a value in the range from 50 mm to 1000 mm, preferably from 100 mm to 500 mm. By means of this kind of fitting, in addition to a longitudinal profile in the machine running direction, a transverse profile at right angles to the machine running direction can be set up in a particular way with substantially higher meaningfulness.

[0029] With regard to the transmission of the measured values from the individual measuring cells, provision is made for the measuring cells to be connected to one another by appropriate connecting lines, in particular cables, and supplied to a preferably common signal converter, or for the transmission of the measured values to a preferably common signal converter to be carried out by means of a radio transmission.

[0030] The measuring cell of the monitoring system according to the invention comprises at least one radioactive source, in particular a Gamma Gage, a laser unit, an ultrasound unit and/or the like. In particular, radioactive sources are shielded appropriately by the abovedescribed embedding of the measuring cell.

[0031] Further advantageous embodiments of the monitoring system according to the invention are specified in the further subclaims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Further features and advantages of the invention emerge from the subclaims and the following description of preferred exemplary embodiments with reference to the drawing, in which:

[0033] figure 1 shows a schematic illustration of two dewatering elements;

[0034] figure 2 shows a second schematic illustration of a dewatering element;

[0035] figure 3 shows a third schematic illustration of a dewatering element;

[0036] figure 4 shows a schematic partial illustration of framing of a paper or board machine;

[0037] figure 5 shows a schematic illustration of a headbox nozzle; and

[0038] figures 6 and 7 show further illustrations of a dewatering element.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0039] Figure 1 shows a schematic illustration of two dewatering elements 5 in the form of foils or strips 6 which are arranged immediately after one another in the machine running direction L (arrow), a large number of dewatering elements 5 of this type generally being provided. These foils or strips 6 can be designed, for example, as forming foils, skimming, supporting or sealing strips.

[0040] Dewatering elements 5 of this type are used in the production of a fibrous web 1, in particular a paper or board web, from at least one fibrous suspension 2 having a fibrous suspension density FSD. In this case, by means of at least one headbox 3 not illustrated in figure 1, the fibrous suspension 2 is applied with a fibrous suspension height FSH to at least one circulating wire 4, which is then led with the fibrous suspension 2 applied over a series of dewatering elements 5. The wire 4 can in particular be part of a fourdrinier former, of a hybrid former or of a gap former.

[0041] Provision is now made for at least one measuring cell 7 fitted in a stationary manner and not in direct contact with the fibrous suspension 2 to be provided for measuring the fibrous suspension height FSH and/or the fibrous suspension density FSD. The two stationary measuring cells 7 illustrated in figure

1 for measuring the fibrous suspension height FSH and/or the fibrous suspension density FSD are fitted close to the surfaces 8 of the dewatering elements 5.

[0042] The measuring cells 7 are connected to one another as indicated in figure 1 by appropriate connecting lines 9 and are supplied to a preferably common signal converter 10, merely illustrated symbolically. Alternatively or additionally, the transmission of the measured values to a preferably common signal converter 10 can also be carried out by means of a radio transmission known to those skilled in the art.

[0043] The measuring cells 7 themselves comprise at least one radioactive source, in particular a Gamma Gage, a laser unit, an ultrasound unit and/or the like.

[0044] Figure 2 shows a second schematic illustration of a dewatering element 5 in the form of a forming roll 11, only the components and subassemblies essential to the invention being shown in this illustration. In this case, the wire 4 with the fibrous suspension 2 resting on the latter is laid over a circumferential region of the forming roll 11 in the machine running direction L (arrow).

[0045] The measuring cell 7 fitted in a stationary manner is in this case introduced into a sealing strip 12, more accurately into the sealing strip 12.2 on the outlet side; however, it can also itself be part of the sealing strip 12. However, in a manner not illustrated, the sealing strip 12.1 on the inlet side can additionally or alternatively also be provided with a measuring cell 7. The introduction itself can be implemented either as embedding in a component surrounding it or as a classical introduction into a preferably specifically produced hollow space 13. In figure 2, the measuring cell 7 is introduced into a hollow space 13 which, if appropriate, can be potted with a medium, in particular a resin, before the measuring cell is commissioned.

[0046] Figure 3 shows a third schematic illustration of a dewatering element 5 in the form of a dewatering box 14.

[0047] Provision is again made for the measuring cell 7 fitted in a stationary manner to be fitted close to the surface 8 of the dewatering box 14 that is

touched by the wire 4. In this case, the fibrous suspension 2 rests on the wire 4 led in the machine running direction L (arrow).

[0048] Figure 4 shows a schematic partial illustration of framing 15 of a paper or board machine.

[0049] In this embodiment, too, provision is made for the measuring cell 7 fitted in a stationary manner to be fitted close to the surface 8 of the framing 15. Furthermore, the circulating wire 4 and the machine running direction L (arrow) are illustrated.

[0050] Figure 5 shows a schematic illustration of a headbox nozzle 16 of a headbox 3 of a paper or board machine. The headbox nozzle 16 of the headbox 3 comprises a headbox slice 17, a dividing element 18 and a slat 19.

[0051] At least one measuring cell 7 fitted in a stationary manner is provided on the aforementioned elements of the headbox nozzle 16, in order in this case to be able to determine as accurately as possible the fibrous suspension density FSD in particular.

[0052] In a further refinement, the headbox 3 can also be provided with sectioned consistency regulation (dilution water technology), as is disclosed, for example, by German patent application DE 40 19 593 A1 (PA04598 DE) from the applicant. The disclosure content of this document is hereby made the subject matter of the present description.

[0053] In all the cases of figures 1 to 5, provision can be made for a plurality of measuring cells fitted in a stationary manner for measuring the fibrous suspension height and/or the fibrous suspension density - viewed at right angles to the machine running direction - to be provided at a plurality of points at a respective distance from one another. The distance between the measuring points can in each case assume a value in the range from 50 mm to 1000 mm, preferably from 100 mm to 500 mm.

[0054] Furthermore, in all the cases, the measured value for the fibrous suspension height FSH and/or the fibrous suspension density FSD obtained by means of at least one measuring cell 7 fitted in a stationary manner and not in direct contact with the fibrous suspension 2 is evaluated in the process control

system 20 associated with the paper or board machine and preferably compared with the at least two predefinable limiting values (upper limiting value, lower limiting value).

[0055] Depending on the result of the evaluation or if at least one of the predefinable limiting values is violated, an actuating element is then automatically activated or influenced appropriately via the process control system 20, in order to signal the violation of the limiting value and/or to initiate at least one appropriate countermeasure, with which a further increase or reduction in the fibrous suspension height FSH and/or the fibrous suspension density FSD of the region monitored is counteracted.

[0056] In this case, the measurement can be part of a control system which, moreover, comprises signal conversion following the measurement and data processing to be carried out by means of the process control system 20.

[0057] Figures 6 and 7 show two further illustrations of a dewatering element 5 in the form of a foil or strip 6. In figure 6, the measuring cell 7 fitted in a stationary manner is enclosed, at least with respect to the side of the wire 4, whereas in figure 7 the measuring cell 7 fitted in a stationary manner forms part of the surface of the foil or strip 6.

[0058] In summary, it is to be recorded that, by means of the invention, a method and an improved monitoring system of the type mentioned at the beginning are provided, by means of which economical and reliable determination and monitoring both of the fibrous suspension height and of the fibrous suspension density are made possible at all measuring points of interest, which may possibly also be complicated or difficult to access.

List of designations

1	Fibrous web
2	Fibrous suspension
3	Headbox
4	Wire
5	Dewatering element
6	Foil or strip
7	Measuring cell
8	Surface
9	Connecting line
10	Signal converter
11	Forming roll
12	Sealing strip
12.1	Sealing strip on the inlet side
12.2	Sealing strip on the outlet side
13	Hollow space
14	Dewatering box
15	Framing
16	Headbox nozzle
17	Headbox slice
18	Dividing element
19	Slat
20	Process control system

FSD	Fibrous suspension density
FSH	Fibrous suspension height
L	Machine running direction (arrow)